NCR

APPLICATION REFERENCE

INQUIRY CONTROL SYSTEM

•

NCR 315

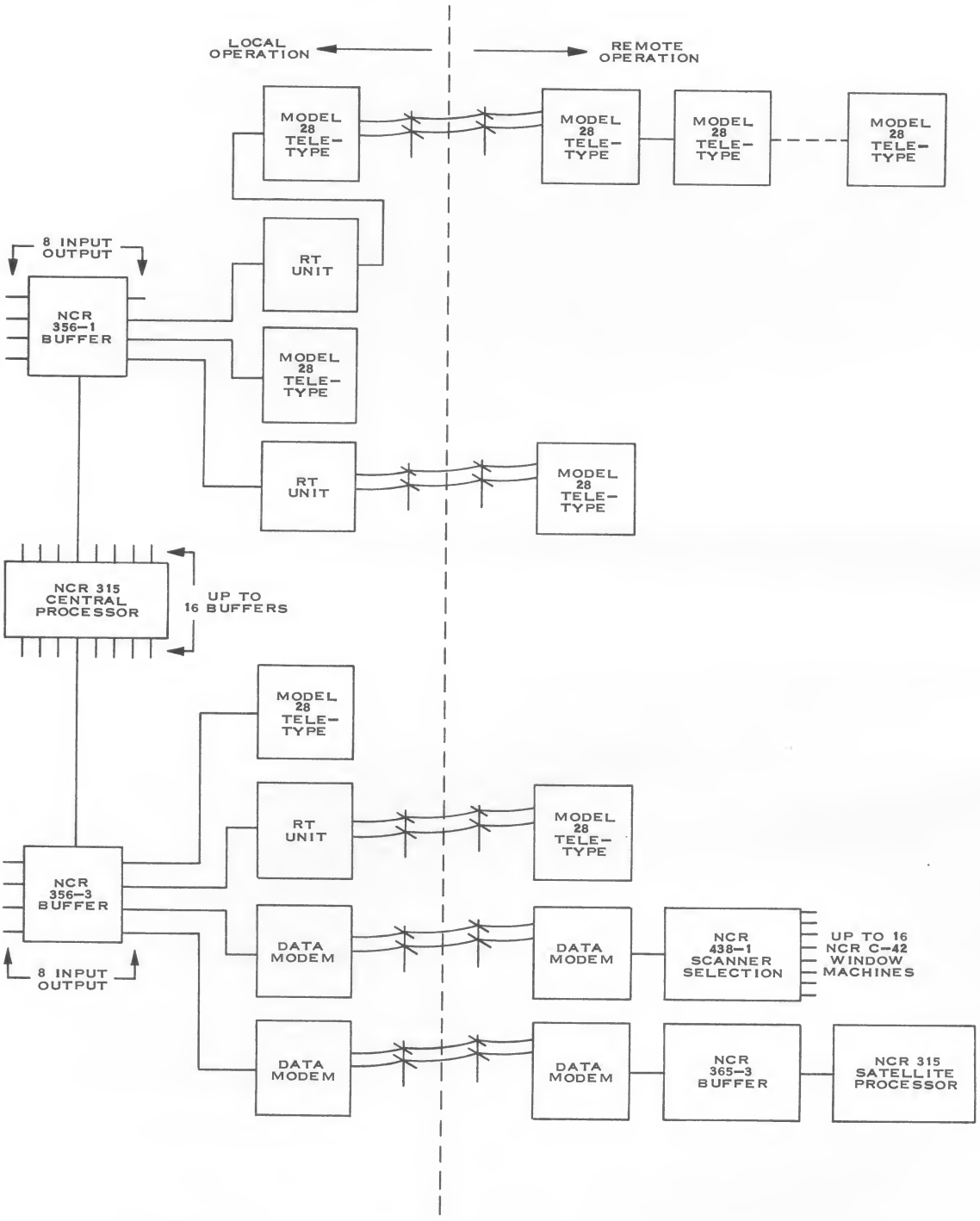

Figure 1. Basic Systems Layout

I. INTRODUCTION

The NCR 315 System is a compact, modular, electronic data processing system, broadly expandable for application as a small-scale, or a large-scale system. Although designed primarily for processing business data, the NCR 315 System has the speed and capacity to process engineering and scientific problems if required.

To provide maximum time-sharing and operating efficiency, most of the peripheral units of the NCR 315 System incorporate an automatic interrupt feature. Inquiry buffers, check sorter readers, high-speed printers, card punches, and magnetic Card Random Access Memories (CRAM), all contain this interrupt feature. The inquiry buffers are used to link the 315 processor with remote input-output devices which may be located up to transcontinental distances from the Processor.

The NCR 315 Processor communicates with the inquiry stations through input-output buffers. Each 315 Processor can accept information from a maximum of 16 buffers, and each buffer can communicate with a maximum of 8 Communication Line Adapters for Teletype (CLAT). Each CLAT unit can communicate with one inquiry station, or in the case of Way Circuit operation, up to 20 inquiry stations. Thus many inquiry stations can be connected to each 315 Processor. The three basic Inquiry Systems are illustrated in figure 1.

The Way Circuit operation mentioned above, is a System which will permit up to 20 Teletype Inquiry Stations to call the 315 Processor using only one set of communication lines and one CLAT. Any Way Station can communicate with any other station in the System and with the Processor. At the NCR 315 Processor location, a Model 28 Teletype and a Model 28 RT unit are employed as the input and output to the NCR 359-3 CLAT.

Special Model 28 ASR Teletype sets are used at all stations, but the master station has an additional control panel. The master station is enabled to send transmitter start patterns to each Way Station in a predetermined sequence. If, when polled, a particular Way Station has tape in the transmitter and is prepared to send, transmission commences and the Way Station is connected to the NCR 315 Processor or to any other designated Way Station. If no messages are ready, the Way Station sends a V-signal back to the control station and the polling pattern continues automatically.

Provision can be made for the most active stations on the circuit to appear more frequently in the polling cycle. Also, the order in which the stations appear in the polling pattern can be selected. Stations located in other time zones and not open for business may be omitted from the polling pattern until a predetermined time.

A spill-over feature is provided in which information is temporarily stored for later transmission. The purpose of the spill-over is to prevent loss of information destined for a distant unit that is temporarily unable to receive. The spill-over information is punched into paper tape for re-transmission at a more convenient time.

REMOTE INQUIRY, A MANAGEMENT TOOL.

Many times management has an immediate need to know the current status of certain company business. Management could look at the last computer prepared report concerning the information needed, but the information on the report would be past history. Decisions based on past history reports could be quite costly both in time and in money. What management really wants is a tool to enable them to obtain current status on certain key information concerning company business. Interrogation of the NCR 315 Processor, equipped with CRAM units and remote inquiry units, is possible by typing the requested information on the Remote Inquiry unit. The wanted data will be typed out on the requesting Remote Inquiry unit.

The Remote Inquiry unit can be used as an auxiliary printer in a key location during a computer run, to inform management to make decisions to correct a situation, soon after the situation has been detected by the computer.

Direct input to the computer from a Remote Inquiry Station keeps company records processed by the computer in current status. The ability of a timekeeper in the manufacturing area to input part numbers and quantity finished, or a receiving clerk to input parts received or parts issued, would enable the company to have an integrated up-to-the-minute Inventory Control System. Such a system would be an extremely valuable tool in the hands of management.

Numerous inquiry applications of the NCR 315 Systems are possible. For example, in mortgage company operations, small branches of the company are linked by Teletype to the home branch, which is

linked directly to an NCR 315 Processor. This central processor, possibly located hundreds of miles away, updates mortgage files and accounts from incoming information, and transmits updated information to branch offices upon request.

In banking, and savings and loan operations, inquiry ststems are used to supply distant branches with up-to-date account status information. The NCR 315 Processor receives daily information from the branches and automatically updates accounts.

In warehouse operations, inquiry systems provide facilities for billing and dispatching of items requested by remote sites. Remote sites are connected to the NCR 315 Processor by Teletype and the Processor is connected with a warehouse, or warehouses by Teletype. When a stock item request is received from a remote location, the NCR 315 Processor searches the files to determine availability and location of the item. If the item is available, the Processor initiates necessary paper work to order and dispatch the item. Master file records are up-dated and if stocks are below predetermined minumum levels, the item is reordered.

This manual has been written as a reference, for use by the Users programmers. It contains only specific information with regard to the Inquiry Control System.

II. INQUIRY CONTROL SYSTEM SPECIAL COMPONENTS

A. INQUIRY STATION EQUIPMENT.

The Model 28 Teletype unit used in the NCR Inquiry System, provides a high-capacity send-receive message station. The following units are available for integration into the Model 28 Teletype.

1. PAPER TAPE READER: Inquiry stations may be equipped with a Paper Tape Reader to accommodate punched tape. The reader can be activated either locally or remotely from the central processor. When the Inquiry station transmits data from paper tape, the tape is read at the Teletype station and data sent over Western Union lines to the central processor. The tape must begin with a start-of-message code and end with an end-of-message code.

2. PAPER TAPE PUNCH: Inquiry stations may be equipped with a Paper Tape Punch which can be operated through the Teletype keyboard or remotely from the central processor. This punch produces perforated 5-channel tape at a maximum speed of 10 characters per second. Serial pulses received from the Processor are translated within the inquiry station equipment to the bit configuration required for punch operation.

3. PRINTER: Operating at a maximum speed of 10 characters per second, the Teletype printer is capable of typing as many as 46 different characters and symbols. Selection of characters is controlled by a local keyboard or by remote Processor control. In addition to the 46 characters, 10 mechanical functions can be selected by key actuation e.g., horizontal tab, vertical tab, feed out, space, and carriage return. Processor selection is by means of a five-level code. The printer can utilize paper up to 9 inches in width for pin feed, or 8-1/2 inches in width for friction feed. When using the automatic form feed-out device, the paper form may be in vertical lengths of 2 to 15 inches.

B. BUFFER EQUIPMENT.

The following equipment is located at the buffer, or central processing end of the communication line.

1. 356-1 INQUIRY BUFFER: Capacity of the 356-1 Inquiry Buffer is one alphanumeric, six-bit character. The rate of transmission is 100,000 characters per second to the Processor, and 10 characters per second to the Teletype. In normal operation when input information is required, the buffer input scanner sequentially examines each of the CLAT input lines. When one CLAT input line is found with a request-to-input signal, the buffer accepts the character. The character is then transferred to the Processor, and the buffer waits approximately 0.2 milliseconds before restarting the input scanner.

   When information is being transmitted from Processor to remote station, the buffer first stops the input scanner, and then accepts data from the Processor. The remote station line is then selected and the buffer transmits the character through the CLAT to the station. Approximately 0.2 millisecond after transmission of the character, the input scanner is started again.

2. 356-3 INQUIRY BUFFER: Also included in the NCR 315 System is a 356-3 Inquiry Buffer with a 17-digit storage capacity. This unit is intended primarily for communication through a 359-1 Communication Line Adaptor (CLA) with the NCR Class 42 Bank Window machine used in savings and loan institutions. The 356-3 Buffer will operate similarly to the 356-1 Buffer when a Western Union Model 28 Teletype and a 359-3 CLAT replace the Class 42 Window machine and the 359-1 CLA.

3. COMMUNICATION LINE ADAPTER: The NCR 359-3 Communication Line Adapter for Teletype (CLAT) is a semiautomatic device used to link the 356-1 Buffer units with the remote Model 28 Teletype units. The CLAT is incorporated within the buffer cabinet, which is located with the Processor at the central site. The purpose of the CLAT is to receive data in serial bit form from the remote inquiry station and convert the data to parallel bit form for use in the Inquiry Buffer unit. Similarly, data transmitted from buffer to remote inquiry station is converted by the CLAT from parallel to serial bit form.

4. MODEL 28 RT SET: A Model 28 RT Set is used at the buffer end of the communication line to store incoming information transmitted by remotely located Teletype units. The RT Set incorporates three important message relaying facilities: a Receiving unit, a Sending unit,

and a Tape Handling unit.

The Receiving unit converts incoming sequential (serial) line signals from the remote Teletype into five-level chadless punched paper tape at speeds up to 100 words per minute. The incoming message is also printed directly on the paper tape.

The Sending unit reads the perforated tape, character by character, and transmits the data through the buffer to the Processor, as requested by the Processor.

The Tape Handling unit consists of a 3000-foot tape supply reel, a 1000-foot tape winder reel, and approximately 100 feet of intermediate storage capacity for perforated tape traveling between the Receiving unit punch and the Sending unit reader.

The Model 28 RT Set provides automatic linkage between the remote Teletype and the 315 System, and eliminates possible troubles caused by transmission delays in long communication lines.

C. COMMUNICATION LINE EQUIPMENT.

The type of communication line equipment used to connect Teletype units with the 315 System is largely dependent upon the distance between units and the Teletype equipment involved, as explained below.

1. WIRE LINES: For local in-house operation, permanent cables are used where convenient to connect Teletype machines to buffer units. For local operation, generally within the same city, full-duplex Western Union communication lines are used where permanent cables are not practical. The inquiry station transmits to the buffer on one line, and the buffer transmits to the inquiry station on the other line. This is not a simultaneous operation, however one line is used for input and the other for output. When data is being transmitted on one line, the other line is used by the receiving unit for control signals.

   For remote operation, generally not in-house or in the same city, half-duplex Western Union communication lines are used. Because of delays introduced by transcontinental distances, control signals cannot be used by receiving units. Data originating at a Teletype is punched into paper tape by a Model 28 RT unit located at the buffer end of the line. The paper tape is then read into the buffer under control of, and at a rate determined by, the Processor.

2. WESTERN UNION WIDEBAND SWITCHING SYSTEM: Western Union has established a new system of private wire services which will enable subscribers to contact each other by dialing predetermined address codes. The basic numbering plan is based upon a seven-digit number, such as 321-4-567. The first three digits (321) represent the Western Union switching center which controls the destination point. The fourth digit (4) indicates the bandwidth of the trunk channel desired, and the last three (567) are associated with the individual subscriber terminal. An optional numbering plan will enable companies utilizing the system to place calls among their various offices with three-digit numbers. This feature will not prevent any station using the special three-digit code from calling any station in the system by means of the seven-digit code.

   This system has a maximum bandwidth of 48 kc, permitting higher transmission quality and reliability for high-speed digital data than possible over voice transmission lines. The Western Union Wideband Switching System will permit full-duplex operation.

III. GENERAL PHILOSOPHY OF THE INQUIRY CONTROL SYSTEM PROGRAM

The heart of the Inquiry Control System (ICS), is an NCR 315 Processor with CRAM and one or more buffers. All data travelling either from the Teletypes to the Processor, or from the Processor to the Teletypes, goes through a Buffer. Data is transmitted one character at a time and is in one of two forms. Between a Teletype and the Buffer it is in serial form; between the Processor and the Buffer it is in parallel form. One of the functions of the Buffer is to convert each character either from serial to parallel or parallel to serial, depending upon it's flow direction.

The Executive and User Programs function as a team to handle remote inquiries. At the beginning of the On-Line day, the Run-to-Run Supervisor reads this combined package into memory and executes the Housekeeping routine contained in the Executive Program. The first Main Program is then called in and at that point the On-Line day has officially begun. It should be noted that the memory area occupied by the Housekeeping routine is made available to the main program or programs, after Housekeeping is executed.

A Teletype operator indicates the start of an input message (to the Processor) by sending a Figures K (left bracket). Each succeeding character is decoded and then placed in that Teletype's input-output area. The Decoding is from Teletype code to (alpha) 315 code. This continues until the Teletype transmits a Figures L (right bracket). Upon receiving this character, the Executive Routine will optionally determine if the number of characters comprising the input message is correct. Should the count not be correct, the Executive Routine will send a ("TRY AGAIN") error message back to the Teletype. If the count is correct, the Executive Routine will optionally search a Master Directory, (which was read into memory during Housekeeping), for the card and track number of the detail directory card that contains the location, (card and track number), of the account record associated with the input message. (See Section VI, Directories for further information).

If the Executive Routine encounters difficulty reading a CRAM record, it will jump to the User Program's tag "ZYCRAMERR". If it finds that the account record sought does not exist, it will jump to the User Program's tag "ZYACCTERR". If the Executive Routine determines that the account record it seeks is a legitimate one and successfully reads it, it will jump to the User Program's tag "ZYNORMAL". When the Executive Routine jumps to "ZYNORMAL", it will have placed in index registers 26 and 27, the following:

IR 26 = will contain the start address (in memory) of the pertinent account record. If these records are fixed length then, of course, the User programmer is aware of this length. He should also know that the first slab of variable length records contains the length of the record (number of slabs in numeric, 4-bit mode):

IR 27 = will contain the start address of the input message. The length of the input message will be known by the User programmer.

If the User programmer did not choose to have the Executive Routine seek the account record, then index register 26 will not have been set by the Executive program. Also, if the Executive Routine jumps to "ZYCRAMERR" or ZYACCTERR", only index register 27 will have been loaded.

At this point the User Program takes over. When it has completed processing the input message it shall have created an output message. If the Executive program had come to the User Program at either tag "ZYCRAMERR" or "ZYACCTERR" then the output message will no doubt be an appropriate error message. If the entry point was "ZYNORMAL" then the output message will be the proper reply to the inquiry. In any case the output message shall overlay the input message. This means that the address of the first slab of the output message shall be the address found in index register 27 when the Executive Routine jumped to the User Program at any of the three previously mentioned entry points. This same address must be in index register 27 when the User Program has completed its processing, i.e., created an output message and returned to the Executive routine at "ZYRETURN".

When the User jumps to the Executive at "ZYRETURN", the Executive expects to find the output in alpha (six bit) mode. In addition, it expects that the first slab will tell the number of characters comprising the output message. Obviously, the output message may not exceed the input/output area set aside for any one Teletype. However, in some cases, the message will exceed this area. In those cases it will be necessary for the User Program to deliver the output message to the Executive Program in segments. The User Program will have to tell the Executive Routine that it has delivered only part of the output message and will want the Executive Routine to return to it when the segment

has been transmitted, so that the next (or last) segment can be placed in the input/output area. The Executive Routine will examine the last slab of each output message area and test the left-hand six bits for a "flag-on" condition. If the flag is on it will return to the user at "ZYNORMAL", after transmitting the message. If it is off, it will take its normal exit after transmitting the output message. The output message will be transmitted to the appropriate Teletype one character at a time. As each character is picked up out of the input/output area, it is encoded (315 alpha to Teletype code) before transmission.

We can summarize all of the preceding into these major processing steps:

1) Assemble a complete input message from a Teletype.

2) Access the appropriate file to obtain the associated master record.

3) Assemble an appropriate output message.

4) Transmit the message to the requesting Teletype.

IV. INPUT AND OUTPUT MESSAGES

A. INPUT MESSAGES.

The Executive Program assembles input messages from Teletype(s) one character at a time. Each character, whether going to or coming from a Teletype goes through the 356 Buffer. Though the 356 is called a one-character Buffer, there are actually two characters involved when the Executive Program reads from or writes to the Buffer. The second (non-information) character identifies the Teletype involved.

When reading from the Buffer, the Executive Program knows in which of the input-output areas to place the input message character on the basis of the identification character. When writing to the Buffer it transmits the proper Teletype identification character (along with the output message character) on the basis of the input-output area it is writing from.

The Executive Program examines each character it reads from the Buffer to determine if it is a Control character, (see table 1), or a non-control character. Only non-control characters are decoded and placed in the appropriate input-output areas. Also, if the Executive Routine is to verify the input message for correct length, it will count only non-control characters. When an input character is decoded, it is converted from Teletype code to a 315 alpha (six bit) character. When the entire input message has been assembled, then each slab will contain two input characters. If the input message is comprised of an odd number of characters, the Executive Program will fill the right half of the last (right-most) slab with an alpha zero. The address of the first slab of the input message will be found in index register 27 when control is turned over to the User Program.

B. OUTPUT MESSAGES.

Output messages are created by the User Program and placed in the input/output area of the Teletype for which the message is intended. The User Program does not actually know which Teletype it is creating a message for, but it does know where in memory to place it. It knows this by the address given to it in index register 27 when the completely assembled input message was delivered to it at "ZYCRAMERR", "ZYACCTERR" or "ZYNORMAL". This same address must be in index register 27 when the User Program has created the output message and returned control to the Executive Program at "ZYRETURN". The Executive Program knows the start address of each Teletype input/output area. By examining the address in index register 27 it knows to which Teletype the message is to be sent.

The output message must be in alpha mode, i.e., two six-bit characters per slab. This also applies to those control characters that the User Program places in the output message (see table 2). It is not necessary for the User Program to output Letters or Figures Shift control characters. The transmission of these is taken care of by the Executive Program. Whether a character is of the Letters or Figures Shift is determined during the encoding process and appropriate shift characters are transmitted as required.

The first slab of each output message must contain, in digit (four bit) form, the count or number of characters to be output. This count should not include the data found in the first (count) slab or the last (flag) slab.

When calculating the count of characters, do include any control characters, such as Line Feed, Carriage Return, etc., that are part of the message. Although Control characters are not counted when they are received during input, they are counted during the output phase.

Summary

1) The User Program creates an output message and places it in a Teletype input/output area. The start address of this area was given to the User Program in index register 27 at the time the Executive Routine transferred control to it. This same address must be in index register 27 when the User Program returns control to the Executive Program at "ZYRETURN".

2) The first slab of the input/output area will contain a count of the characters in the output message.

3) The last slab of the input/output area will be used as a flag. If the left hand flag of this slab is on, the Executive will transmit the output message and return control to the User at "ZYNORMAL".

TABLE 1. OUTPUT MESSAGE CONTROL CHARACTERS

CHARACTER	CONTROL FUNCTION
< or $\bar{d}$	Carriage return
= or £	Line Feed
or $\bar{x}$	Feedout
← or $\bar{o}$	Horizontal tab
↑ or $\bar{p}$	Vertical tab
[or $\bar{v}$	Transmit remote tape (TRT)
> or $\bar{s}$	Bell

TABLE 2. CONTROL CHARACTERS

That May Not Be Used	That Will Be Ignored
' (Apostrophe)	@
(	+
)	
!	%
;	*
"	] or $\bar{w}$

V. REGISTERS

As mentioned in Section III of this manual, index registers 26 and 27 are used to "point at" the start t of the Master Account Record and input message respectively, when the Executive Routine turns control over to the User Program. Any of the normally usable index and jump registers are available to the User programmer. However, the following rules must be observed:

1) Index registers 26 and 27 should be used for the purpose mentioned in Section III.

2) If it is necessary to use them for other purposes, it must be remembered that index register 27 must contain the same value at ZYRETURN (exit from the User Program) as it had at ZYCRAMERR, ZYACCTERR, and ZYNORMAL (entries to the User Program).

3) Before using any registers, they must be stored before using and restored after using.

In some cases the User's programmer will, (unknowingly), choose to use registers being used also by the Executive and/or main programs. This is allowable because the User Program is not Demand Interruptable. However, the above rules must be strictly followed to prevent interactions between programs.

VI. DIRECTORIES

The User's programmer may optionally have the Executive Program access the account record relevant to an inquiry input message. When this option is chosen, the Executive Routine uses a two-step directory search to find the desired record. It first searches a Master Directory, which refers it to a Detail Directory, which in turn directs it to the account record.

The Master Directory must be fully contained on track zero of a card specified by the User in one of the Macro parameters. During the execution of the Housekeeping portion of the Executive Routine, the Master Directory is read into memory.

The Detail Directory begins on track one of the same card that contains the Master Directory. The remainder of the Detail Directory is recorded on successive tracks of successive cards. However, track six of all Directory Cards will be left unused. This track will be used to store that portion of memory that may be used both as Main Program area and CRAM buffer, (input), area. This sharing of memory is an option chosen by each Main Program (see Main Program Section VIII).

In some cases the memory area designated for use by Main Programs will not be large enough to accommodate one or more of them. As the Memory Map, Figure 2 shows, immediately following the area set aside for Main Programs, are two areas used by the Executive Program Housekeeping routione, followed by the CRAM buffer area. These three areas are available to the Main Programs when necessary. If a Main Program overlaps the CRAM buffer area, then the option mentioned in the previous paragraph will be chosen by the Main Program. To clarify this, we will assume that the following conditions exist:

1) The CRAM buffer area has been used by the Main Program.

2) The User Program has elected to have the Executive Program access the CRAM records associated with inquiry messages.

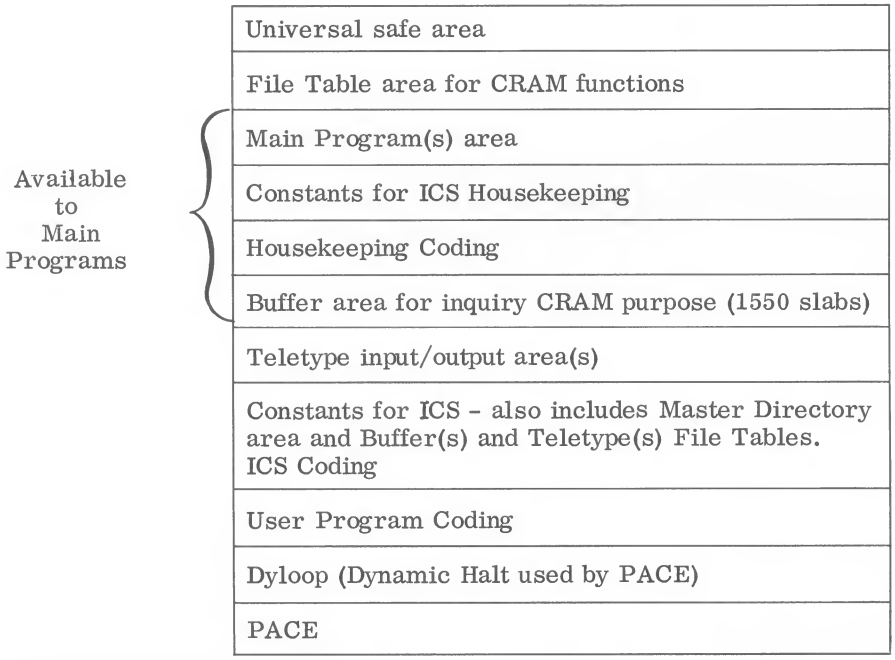

Figure 2. Memory Map

The processing steps taken after a complete input message has been assembled are:

1. Search the Master Directory to determine the card and track number of the associated Detail Directory card.

2. Drop the Detail Directory card.

3. Write, onto track six of the Detail Directory card, that portion of the Main Program that has

overlapped the CRAM buffer area.

4. Read the appropriate track of the Detail Directory card into the CRAM buffer area.

5. Search the Detail Directory for the card and track number on which is recorded the account record associated with the remote inquiry message.

6. Drop the account record card.

7. Read the appropriate track of the account record card into the CRAM buffer area.

8. Search the track for the account number in question.

9. Turn control over to the User Program with index registers 26 and 27 properly loaded (see Registers section).

When the User Program returns control to the Executive Program (at ZYRETURN) the Executive Program will:

10. Drop the Detail card mentioned in step 2 above.

11. Read track six into the CRAM buffer area thereby restoring the Main Program.

12. Begin transmitting the output message developed by the User Program (between 9 and 10 above.

The Main Program can be bisected in this manner because no portion of it will be executed between the time a complete input message has been assembled and the start of transmission of an output message. In other words, the Demand Permit flag is off and control will not be returned to the Main Program during the time that part of it is not in memory.

If, after performing the functions in steps 5 or 8 above it is determined that the account number sought does not exist, the Executive routine will jump to the User Program tag ZYACCTERR. The way that an account number is determined as "non-existent" is through one of the following:

1. One of the Macro parameters, given by the User's Programmer, tells the Executive routine the length of the Master Directory, i.e., how many account numbers make up the Master Directory. If the Executive routine, after comparing the account number given in the input message to the last (and highest) account number in the Master Directory, finds the input message account number to be greater, then this means that the account number sought does not exist and hence the jump to ZYACCTERR.

2. If the Master Directory has directed the Executive routine to a certain Detail Directory card and track, because the account number in the input message is within the range of numbers stored on that track, and does not find a record corresponding to the account number sought, the Executive routine will jump to the User's tag ZYACCTERR.

The User's Programmer may elect not to have the Executive Program access CRAM records for him, but rather perform this function himself. Should he elect the latter, then he assumes the task of searching for the account record. This also means that once the input message has been assembled, control is transferred to the User Program (at ZYNORMAL) with only index register 27 loaded.

A. BUILDING THE DIRECTORIES.

1. Master directory.

   In creating the Master Directory, the User Programmer must use the following format:

   *An integral number of slabs sufficient to contain a complete account number.

   8 (low order) bits equal binary card number

   4 (high order) bits equal track number

2. Detail directory.

   In creating the Detail Directory the User Programmer must use the following format:

   *An integral number of slabs sufficient to contain a complete account number

   8 (low order) bits equal binary card number

   4 (high order) bits equal track number

   Number of the CRAM unit containing the account records associated with this track's Directory references. This appears once per track.

*Account number must consist only of integral slabs with the data right-justified (e.g. a 7-digit account number must occupy the 7 low order digits of a 3-slab word and the 2 high order digits must be zero). This implies that the account numbers in the Directory are in numeric (4-bit) mode. When the Executive routine searches for account records it converts the alpha (six bit) account number input message to numeric (four bit) mode, in a work area in memory, before comparing it to Directory segments. This does not imply that the input message will be delivered to the User Program in numeric mode, but rather the opposite is true. If the user searches for account records, then he must make this conversion before comparing the input message to the Directory segments.

B. SUMMARY.

1. Master Directory.

   a) The first segment of the Master Directory will contain the track and card number of the first Detail Directory track, (track one of the same card that contains the Master Directory). The account number given in this segment will be that of the last account number referenced on track one, (of the Detail Directory). The second segment will tell the last account number referenced on track two of that card, and so on with each succeeding segment.

   b) The Master Directory must be fully contained on track zero of a card whose number must be given as one of the Macro Parameters. Additional Macro parameters that must be given are:

      1. The number of slabs required to contain one account number in numeric (4-bit) mode, and,
      2. The number of segments comprising the Master Directory; i.e., how many tracks are required for the entire Detail Directory.

C. DETAIL DIRECTORY.

1. The first slab, (following the four-slab PACE label), of each Detail Directory track will contain the number of the CRAM unit containing the account records associated with that track's references.

2. The account numbers given in the Detail Directory segments will be that of the last account record found on each track of the accounts Master File.

The formats and rules given in this section regarding directories and formats apply only when the User has chosen to have the Executive Program access the CRAM records associated with inquiry messages. If the User elects to perform this function, then, of course, any directory format and/or search method may be used. Track six may be used for directory information provided none of the Main Programs exercise the option to share memory.

VII. WRITING THE USER PROGRAM

This section will be divided into three parts. The first will state the rules to be followed and give information that is common to both the situation where the User accesses the CRAM records and where the Executive Routine performs this function. The second part relates rules and information peculiar to the case where the Executive Routine accesses the CRAM records and the third part is relevant when the User Program accesses these records.

A. RULES FOR WRITING USER PROGRAM.

1. Provide an entry for the Executive Routine tagged ZYNORMAL. When the Executive is ready to turn control over to the User it will JUMP to this tag. Exceptions to this will occur when the User has elected to have the Executive access the CRAM records and the Executive either finds the record sought does not exist or it encounters CRAM read errors (see Steps B and C following).

2. When the User wishes to return control to the Executive, it should JUMP to the Executive at tag ZYRETURN.

3. Create an output message for each inquiry input message. It is suggested that, in order to signal the Teletype operator that the last output character has been transmitted to the Teletype, a special character be printed as the last character or that the Teletype bell be rung.

4. If the output message is larger than the Teletype's input/output area, then the message must be sent in two or more segments. To signal the Executive that, after transmitting this message, control is to be returned to the User, the left flag of the last slab of the output message must be on. Care must be taken to assure that this slab be used only as a flag and not for storing data.

5. If input messages are variable in length, verify for correct length, (perhaps on the basis of an input code).

B. CRAM RECORDS ACCESSED BY EXECUTIVE ROUTINE.

1. Provide two entries (in addition to ZYNORMAL) tagged ZYACCTERR and ZYCRAMERR. The Executive will JUMP to the former if it cannot find the CRAM record associated with an inquiry input message; the latter if it cannot read the record. In either case the User will probably want to create a message to be sent to the inquiring Teletype unit informing the operator of the error condition.

2. Provide a master and Detail Directory, (see Directories Section VI.).

C. CRAM RECORDS ACCESSED BY USER PROGRAM.

1. Examine flag M, (right half of slab 00118), and if off, write N slabs, starting at location ZYREADCRAM, onto an unused CRAM card track. N is defined as the maximum number of slabs recorded on any CRAM track that will be read into that area, (plus 4 slabs for the label).

VIII. MAIN PROGRAMS - DEMAND INTERRUPT

Teletype communication with the processor is accomplished via the 356-1 Inquiry Buffer. When a character is transmitted from a Teletype it is routed to this Buffer. Like other peripherals, the 356-1 has program controlled Unit Demand flags. The Executive Routine turns each Buffer's unit (input) Demand flag on in Housekeeping. This unit input or read demand flag being "on", allows the Buffer to signal the processor its desire to Demand Interrupt it. Whether or not the processor will allow the Buffer to Demand Interrupt is dependent on the state of the processor's Demand Permit flag. If, through programming, (SETF:D), the flag is on, then the processor may be Demand Interrupted. The importance of the last sentence is that any peripheral that is READY and has its Unit Demand flag ON will transmit a demand signal to the processor; if the processor's Demand Permit flag is set, Demand Interrupt will occur. When the processor is Demand Interrupted, it takes its next instruction from the address stored in jump register 30. When the ICS program is in memory and operating, this address will be that of the start of the Executive Program. It can be seen that if the processor is interrupted by any peripheral other than a 356-1 Buffer, the results would be anything but desirable. One of the first rules regarding Main Programs then is:

A. Main Programs should not use Demand Interrupt. If it is necessary to use the card reader, or any other peripheral exercising Demand, the processor's Demand Permit flag should be turned OFF before such operations and ON again afterward remembering that the Unit Demand flags of the peripherals involved should be cleared before restoring the processor's Demand Permit flag. Note: While the processor's Demand Permit flag is off, Teletype operation is inhibited, therefore explaining the rule above.

   Another basic requirement of Demand Interrupt is that the processor be in a dynamic state at all times. This brings up two more rules:

B. A Main Program, of some sort, must be in operation at all times, (even if it is only a short jump loop).

C. Main Program coding should not include "HALT". Demand Interrupt cannot occur while the processor is in REST. If a HALT is necessary then it should be a dynamic halt, i.e., centered around a TEST:SW command(Note - The special version of PACE, used with ICS, uses this technique).

In the previous paragraphs it was said that programmed HALTS and the use of Demand Interrupt should be avoided in Main Programs. It was also stated that the processor should "be in a dynamic state at all times". While programmed HALTS and turning the processor's Demand Permit flag OFF are fairly obvious violations of the "do's and don'ts" there are some other operations that are not so obvious as described in the following rule:

D. Long duration commands such as those dealing with magnetic tape and console typewriter operations should be avoided. If necessary at all they should be kept to a minimum.

The state of a flag (M) in the Universal Safe Area tells the Executive (or User) program whether or not the CRAM read in area is being shared by the Main Program(s). The Librarian must set or clear this flag in each program to indicate if that particular program will or will not overlap the CRAM area. If flag M, (right half of slab 00118) is:

ON = Don't share CRAM area

OFF = Main Program overlaps CRAM area; must be saved before reading a CRAM track.

CRAM Sorts

Column 57 of the first Control Card for any On-Line CRAM sorts, must contain a Hollerith "Y". This tells the sort that ICS is in memory and prevents it from using the ICS memory area.

IX. TELETYPE OPERATION

The Teletypes used in an NCR Inquiry Control System, have been specially modified for use in the system. These modifications are as follows:

1. The addition of a special "Transmit" button. This button is mounted on the top or front of the Teletype cabinet but not on the keyboard.

2. Recognize a "Figures K", (left bracket), as the start of message, (S. O. M.), character.

3. Recognize a "Figures L:, (right bracket), as the end of message, (E. O. M.), character.

Immediately adjacent to the Transmit button, (in Step 1 above), is a status light. Depression of the Transmit button turns off the status light indicating that the Teletype has gone into the transmit mode; however, this does not "lock" the Teletype in this mode. This means that the processor could send data to it thereby returning it to the receive mode. A teletype can be locked in the transmit mode by pressing the Transmit button and entering "Figures K", (S. O. M.), on the keyboard. Now the operator may begin sending the input message without fear of being interrupted by the processor. Entering "Figures L", will turn the status light on and return the Teletype to the receive mode.

A. OPERATING PROCEDURES.

1. To transmit an inquiry message to the processor.

   a. The Teletype must be "ON". The off/on switch is located below and to the right of the keyboard.

   b. Depress the Transmit button thereby turning off the status light.

   c. Enter "Figures K", (S. O. M.), on the keyboard.

   d. Enter the input message.

   e. Enter "Figures L", (E. O. M.), on the keyboard (status light will go on).

If, while entering an input message, but before entering Figures L, the operator notices that a mistake has been made, (transposition, missing or incorrect character, etc.), the operator may correct the error by re-entering the entire message beginning with the S. O. M. , (figures K), character. This tells the processor to disregard the previous input from this Teletype.

If the Teletype operator has more than one message to send, he must wait for response to the first inquiry before sending the next.

X. GLOSSARY

A. EXECUTIVE PROGRAM (Routine)
NCR prepared software that handles all communications with remote, (or local), inquiry units.

B. I. C. S.
Inquiry Control System.

C. MAIN PROGRAM
Any program operating in memory exclusive of the Inquiry package.

D. USER PROGRAM
The variable portion of the I. C. S. package. It is, itself, a custom program for its particular application and, in turn, through the use of Macros, generates a custom Executive Program.

An Educational Publication
Marketing Services Department
THE NATIONAL CASH REGISTER COMPANY — DAYTON 9, OHIO

PRINTED IN U.S.A. SP-1100-J15SSS